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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

PRELIMINARY ANNOUNCEMENT OF THE FIFTH CHICAGO MEETING

By Dr. F. R. MOULTON

PERMANENT SECRETARY

FROM September 22 to September 27, inclusive, the association will join with The University of Chicago in celebrating the fiftieth anniversary of its founding. The university has organized a program of addresses by distinguished scientists and scholars and an extensive series of symposia in the fields of the natural sciences and the humanities under the general title "New Frontiers in Education and Research." Outlines of the programs of these addresses and symposia were published in the July 4 issue of SCIENCE, pages 20–22.

This is the fifth meeting of the association in Chicago. The earlier meetings were held in 1868, 1908, 1920 and 1933, the latest in connection with the Century of Progress Exposition organized in celebration of a century of progress through science. The theme of the exposition was proposed by Dr. Michael I. Pupin, president of the association in 1925.

Persons attending the meeting in Chicago may arrange for convenient living accommodations in the Residence Halls of the university by writing the Director of the Fiftieth Anniversary Celebration for reservations. It is suggested that those desiring rooms on the university campus write promptly (not later than August 25) for reservations because the number that will be available is limited. Each applicant

should state precisely the period for which accommodations are desired. The rates are $2.00 per day for room and breakfast or $3.00 per day for room and all meals. There are several residence hotels within easy reach of the university, the principal ones being the Chicago Beach, the Del Prado, the Shoreland, the Windermere, the Aragon, the Broadview, the Fairfax, the Flamingo, the Hyde Park, the Plaisance and the Sherry, which can accommodate limited numbers of guests at minimum rates of $2.50 to $3.50 for single room and bath and of $3.00 to $5.00 for double room and bath. Reservations should be made directly with the hotels.

It is important, too, that all persons expecting to attend the celebration should inform the university not later than August 25 for which of the symposia they desire to register.

Since the university is about seven miles from the railroad passenger terminals near the center of the city, those arriving over eastern, southern and southwestern railroads should leave their trains at suburban stations on Sixty-third Street. The university may be conveniently reached from downtown Chicago by Illinois Central suburban trains, the downtown stations of which are east of Michigan Avenue in the direction of Lake Michigan.

Headquarters and Mail

Headquarters for the meeting will be in Ida Noyes Hall on the university campus. Persons attending the meeting should register (without charge) so that there will be a record of their local addresses for convenience in distributing mail and for use in getting into contact with them. Programs of the meeting will be distributed at the headquarters.

General Sessions

At each of its meetings, the association holds several general sessions at which distinguished scientists discuss subjects of wide interest. A number of such sessions have been arranged for, all except one by the university. Since they have already been announced in the July 4 issue of SCIENCE, page 22, a brief résumé of them will be sufficient. They begin on Monday afternoon, September 22, and continue through Friday, September 26.

The subjects of the general addresses are: (Monday) The Social Implications of Vitamins, by Dr. Robert R. Williams; (Tuesday) The Physiology of the Amino Acids, by Dr. Donald D. Van Slyke; (Wednesday) Spinors and Projective Geometry, by Dr. Oswald Veblen; Some Unsolved Problems of Theoretical Dynamics, by Dr. George D. Birkhoff; Textile Research in the Interest of the Consumer, by Dr. Ruth O'Brien; (Thursday) Tuberculosis as the Chemist Sees It, by Dr. Florence B. Seibert; Glaciation and Submarine Valleys, by Dr. Reginald A. Daly; Advancing Frontiers in Nursing Education, by Dr. Isabel M. Stewart; The Historical Interpretation of Art and Literature, by Halvdan Koht; (Friday) Nuclear Transformations, by Dr. Ernest O. Lawrence; The Cosmical Abundance of the Elements, by Dr. Henry Norris Russell; The Significance of Choline as a Dietary Factor, by Dr. Charles H. Best; and Virus Infection of the Mammalian Foetus, by Dr. Ernest W. Goodpasture.

Symposia Programs

For the convenience of members of the association, the symposia programs will be listed on the basis of their subjects in the order, so far as is possible, of the sections of the association.

Section on Mathematics (A)

Under the joint auspices of the section, the American Mathematical Society and the Mathematical Association of America, the annual Josiah Willard Gibbs Lecture will be delivered on September 3, by Sewall Wright, The University of Chicago, on "Statistical Genetics and Evolution." For further information about the programs of the societies, which meet in Chicago on September 2 to 6, see the July 11 issue of SCIENCE, page 36.

The section and the two affiliated mathematical societies sponsor the general session on Wednesday, September 24, at which Drs. Oswald Veblen and George D. Birkhoff will deliver addresses, the former on "Spinors and Projective Geometry" and the latter on "Some Unsolved Problems of Theoretical Dynamics."

Sections on Physics (B) and Astronomy (D)

Cosmic Rays. Friday, September 26.

Contributors: Robert A. Millikan, California Institute of Technology; William P. Jesse, Marcel Schein and Ernest O. Wollan, The University of Chicago; Bruno Rossi, Cornell University; S. Chandrasekhar, The University of Chicago.

Section on Chemistry (C)

Organic Chemistry. Monday–Tuesday, September 22–23.

Contributors: William A. Noyes, Jr., University of Rochester; James Franck, The University of Chicago; Louis P. Hammett, Columbia University; Frank H. Westheimer, The University of Chicago; Linus C. Pauling, California Institute of Technology; George W. Wheland, The University of Chicago; Lawrence O. Brockway, University of Michigan; Simon H. Bauer, Cornell University; Francis O. Rice, Catho-

lic University of America; Morris S. Kharasch, The University of Chicago.

Surface Chemistry. Tuesday–Wednesday, September 23–24. In honor of Dr. William D. Harkins on the twenty-fifth anniversary of the publication of his first paper in the field.

Contributors: Fritz London, Duke University; William D. Harkins, The University of Chicago; John G. Kirkwood, Cornell University; Henry Eyring, Princeton University; Eugene Guth, University of Notre Dame; Henry B. Bull, Northwestern University Medical School; George H. A. Clowes, Eli Lilly and Company; Eli F. Burton, University of Toronto; Irving Langmuir and Vincent J. Schaefer, General Electric Company; George E. Boyd, The University of Chicago; Ernst A. Hauser, Massachusetts Institute of Technology; Adrian J. Grossman.

SECTION ON GEOLOGY AND GEOGRAPHY (E)

Frontiers of Knowledge in the Geologic Sciences. Thursday–Friday, September 25–26.

Leaders of discussions: Ralph E. Grim, Gilbert H. Cady, Illinois Geological Survey; Richard F. Flint, Yale University; A. I. Levorsen, Research Committee of the American Association of Petroleum Geologists.

SECTIONS ON THE ZOOLOGICAL SCIENCES (F) AND THE BOTANICAL SCIENCES (G)

The Respiratory Enzymes and the Biological Actions of the Vitamins. Thursday–Saturday, September 11–13, at Madison, Wisconsin, Monday–Wednesday, September 15–17, at Chicago, under the joint sponsorship of The University of Chicago and the University of Wisconsin. For information and reservations address Dr. T. R. Hogness, The University of Chicago.

The Training of Biologists. Thursday–Saturday, September 18–20. For information and reservations address Dr. Paul A. Weiss, The University of Chicago.

Growth and Differentiation in Plants. Ezra J. Kraus, The University of Chicago, *chairman.* Monday morning, September 22.

Contributors: Charles E. Allen, University of Wisconsin; John M. Beal, The University of Chicago; Edmund W. Sinnott, Yale University; John W. Mitchell, U. S. Department of Agriculture.

SECTIONS ON THE BIOLOGICAL SCIENCES (F, G) AND ON THE SOCIAL AND ECONOMIC SCIENCES (K)

Levels of Integration in Biological and Social Systems. Tuesday–Wednesday, September 23–24.

I. Organismic Aspects. Warder C. Allee, The University of Chicago, *chairman.*

Contributors: Libbie H. Hyman, American Museum of Natural History; James W. Buchanan, Northwestern University; Ralph W. Gerard, The University of Chicago.

II. Group of Population Aspects. William H. Taliaferro, The University of Chicago, *chairman.*

Contributors: William Burrows, The University of Chicago; Herbert S. Jennings, Johns Hopkins University and University of California at Los Angeles; Thomas Park and Warder C. Allee, The University of Chicago.

III. The Comparative Study of Societies. Robert Redfield, The University of Chicago, *chairman.*

Contributors: Alfred E. Emerson, The University of Chicago; Clarence R. Carpenter, Pennsylvania State College; Alfred L. Kroeber, University of California; Robert E. Park, The University of Chicago.

SECTIONS ON THE BIOLOGICAL SCIENCES (F, G) AND ON THE MEDICAL SCIENCES (N)

Problems in Aerobiology. Monday–Tuesday, September 22–23. This symposium, organized by Sections F, G and N, consists of two parts, the first dealing with exterior wind-borne biological units and the second with interior wind-borne biological units. The details of the program will be announced in a later issue of SCIENCE.

SECTIONS ON PSYCHOLOGY (I) AND ON THE MEDICAL SCIENCES (N)

Visual Mechanisms. Karl S. Lashley, Harvard University, and Selig Hecht, Columbia University, *chairmen.* Wednesday, September 24.

Contributors: Selig Hecht, Columbia University; Arlington C. Krause, The University of Chicago; Ernst Gellhorn, University of Illinois; Heinrich Klüver, The University of Chicago; Theodore J. Case, The University of Chicago; Samuel H. Bartley, Washington University; Stephen Polyak, The University of Chicago; Karl S. Lashley, Harvard University.

SECTION ON SOCIAL AND ECONOMIC SCIENCES (K)

The Public Social Services: Fifty Years of Progress. Edith Abbott, The University of Chicago, *chairman.* Monday morning, September 22.

Contributors: Helen R. Wright, The University of Chicago; Martha Eliot, U. S. Children's Bureau; Carter Goodrich, Columbia University.

The Changing Bases of National Economy. Paul H. Douglas, The University of Chicago, *chairman.* Tuesday morning, September 23.

Contributors: John M. Clark, Columbia University; Frank H. Knight and Theodore O. Yntema, The University of Chicago.

Management's Adjustment to the Changing National Economy. William N. Mitchell, The University of Chicago, *chairman.* Tuesday afternoon, September 23.

Contributors: Willard L. Thorp, Dun and Bradstreet, Inc.; Lewis C. Sorrell, Raleigh W. Stone and James W. Young, The University of Chicago.

Measurement and Experiment. William F. Ogburn, The University of Chicago, *chairman.* Wednesday afternoon, September 24.

Contributors: Samuel S. Wilks, Princeton University; Louis L. Thurstone, The University of Chicago.

Civilizations in Transition. Louis Gottschalk, The University of Chicago, *chairman.* Wednesday afternoon, September 24.

Contributors: Michael I. Rostovtzeff, Yale University; His Excellency Hu Shih, Ambassador of China to the United States; Robert H. Lowie, University of California.

The Place of Law in Society. Charles E. Merriam, The University of Chicago, *chairman.* Thursday afternoon, September 25.

Contributors: Robert H. Lowie, University of California; Charles H. McIlwain, Harvard University; Hans Kelsen, University of Vienna and Harvard University.

The Place of Ethics in Social Science. John Ulric Nef, The University of Chicago, *chairman.* Friday morning, September 26.

Contributors: Robert Maynard Hutchins, The University of Chicago; Richard H. Tawney (tentative), University of London; Charles H. McIlwain, Harvard University; Jacques Maritain, Catholic Institute of Paris and Columbia University.

Administrative Agencies—Recommendations of the Attorney-General's Committee. Wilber G. Katz, The University of Chicago, *chairman.* Saturday evening, September 27.

Contributors: John Foster Dulles, the New York Bar; Walter Gellhorn, Columbia University; John Dickinson, University of Pennsylvania.

Section on Historical and Philological Sciences (L)

Approaches to Linguistics. Clarence E. Parmenter, The University of Chicago, *chairman.* Monday morning, September 22.

Contributors: Edgar H. Sturtevant, Yale University; Amado Alonso, University of Buenos Aires; Clarence H. Faust and Charles W. Morris, The University of Chicago; Vincent J. Flynn, College of St. Thomas; William C. Korfmacher, St. Louis University.

The Editing of a Text. William A. Nitze, The University of Chicago, *chairman.* Monday afternoon, September 22.

Contributors: Edward C. Armstrong, Princeton University; Charles H. Beeson and James R. Hulbert, The University of Chicago; Gustave O. Arlt, University of California at Los Angeles; Rae Blanchard, Goucher College; William Roach, University of Pennsylvania.

Interpretation and Criticism of Art and Literature. Ronald S. Crane and Ulrich A. Middeldorf, The University of Chicago, *chairmen.* Tuesday, September 23.

Contributors: Henri Frankfort, The University of Chicago; Charles R. Morey, Princeton University; Lily Bess Campbell, University of California at Los Angeles; G. Haydn Huntley, Robert Vigneron and Norman F. Maclean, The University of Chicago; Van Meter Ames, University of Cincinnati; Bernard Weinberg, Washington University; Elder Olson, Illinois Institute of Technology.

Philosophic Procedures in the Arts and Sciences. Richard P. McKeon, The University of Chicago, *chairman.* Wednesday, September 24.

Contributors: Robert L. Calhoun, Yale University; Friedrich Kessler and Frank H. Knight, The University of Chicago; Clarence I. Lewis, Harvard University; Charles Hartshorne, The University of Chicago; George V. Gentry, University of Texas.

Problems in Historical Materials. Wilbur K. Jordan, The University of Chicago, *chairman.* Thursday morning, September 25.

Contributors: William L. Westermann, Columbia University; Richard P. McKeon and Bernadotte E. Schmitt, The University of Chicago; Ray W. Frantz, University of Nebraska, Alfred P. Dorjahn, Northwestern University; Loren C. MacKinney, University of North Carolina; Stuart R. Tompkins, University of Oklahoma.

Archeology as a Tool in Humanistic and Social Studies. Albert Ten Eyck Olmstead, The University of Chicago, and William L. Westermann, Columbia University, *chairmen.* Friday morning, September 26.

Contributors: Robert L. Engberg, American School for Oriental Research at Jerusalem; Michael I. Rostovtzeff, Yale University; Neilson C. Debevoise, The University of Chicago, Harold R. Willoughby, The University of Chicago; Richard A. Parker, The University of Chicago.

Section on the Medical Sciences (N)

The Theobald Smith Award in Medical Sciences. Monday afternoon, September 22. Each year at its annual meeting the association determines the recipient of its Theobald Smith Award for the ensuing year. The award consists of a bronze medal and one thousand dollars in cash, provided by the Eli Lilly Company of Indianapolis, Indiana. The recipient

presents a paper and receives the award at the summer meeting of the association following the annual meeting at which it was voted. The recipient of the award for 1941 is Herald R. Cox.

"Cultivation of Rickettsiae of the Rocky Mountain Spotted Fever, Typhus, and Q Fever Groups in the Embryonic Tissues of Developing Chicks," Herald R. Cox, Rocky Mountain Laboratory, Hamilton, Montana.

Life at High Altitudes and Aviation Medicine. Anton J. Carlson, The University of Chicago, *chairman.* Tuesday morning, September 23.

Contributors: Carlos Monge, University of San Marcos, Peru; David Bruce Dill, U. S. Army; E. S. Guzmán Barrón, The University of Chicago.

Thoracic Diseases. Dallas B. Phemister, The University of Chicago, *chairman.* Thursday morning, September 25.

Contributors: Clayton G. Loosli and William E. Adams, The University of Chicago; Evarts A. Graham, Washington University; John Alexander, University of Michigan; Oswald H. Robertson and Robert G. Bloch, The University of Chicago.

Sex Hormones. Frank R. Lillie, The University of Chicago, *chairman.* Friday morning, September 26.

Contributors: Carl R. Moore and Allan T. Kenyon, The University of Chicago; Edward A. Doisy, St. Louis University; John S. L. Browne, McGill University; Fred C. Koch, The University of Chicago.

Immunological Mechanisms. George F. Dick, The University of Chicago, *chairman.* Friday morning, September 26.

Contributors: William Bloom, The University of Chicago; Linus C. Pauling, California Institute of Technology; Thomas M. Rivers, The Rockefeller Institute for Medical Research.

The Section on Education (Q)

Environment and Education. Robert J. Havighurst, The University of Chicago, *chairman.* Monday morning, September 22.

Contributors: Ernest W. Burgess, The University of Chicago; Franz Alexander, Institute for Psychoanalysis, Chicago; W. Lloyd Warner, The University of Chicago; Margaret Mead, American Museum of Natural History.

The Conceptual Structure of Educational Research. Guy Thomas Buswell, The University of Chicago, *chairman.* Tuesday afternoon, September 23.

Contributors: Thomas R. McConnell, University of Minnesota; Douglas E. Scates, Duke University; Frank N. Freeman, University of California.

COLLOIDS IN ASTRONOMY AND METEOROLOGY

By JEROME ALEXANDER

NEW YORK, N. Y.

THE slight, irregular motion of tiny particles approximating the limits of microscopic resolvability was named in honor of Robert Brown, a Scotch botanist, who first drew attention to this phenomenon in 1827. Since non-living particles exhibit Brownian motion, there were many speculations as to its cause. It was often called "pedesis," because the particles seemed to "walk" about, and as early as 1896 Sir William Ramsay connected it up with the kinetic theory by expressing the view that there was a gradual transition between particles in gases or in solution, and particles in suspensions. The discovery of the ultramicroscope in 1903 by Richard Zsigmondy brought visual proof of the correctness of this view, for it brought into *visibility* particles as small as 5 mμ (five millionths of a millimeter). Since such submicroscopic particles are smaller than the wave-lengths of visible light, they can not be resolved, although they may be seen as "points" of varying degrees of luminosity and of Brownian activity. Calculations by Perrin, Einstein, Smoluchowski and others proved that the nature of the motion seen was what the kinetic theory demanded for particles of this size. Similarly, in the astronomical field, the discs of the sun and the moon may be resolved visually, and even small telescopes will resolve the larger planets; but not even the most powerful telescopes can resolve any of the fixed stars.

While no natural arbitrary limits exist for particles in what we now term the colloidal state of dispersion, these limits are, roughly, between 100 and 5mμ; that is, they begin just about the zone of microscopic resolvability and run down to dimensions commonly attributed to large molecules. It must be emphasized that particle size, that is, degree of subdivision or dispersion, is the criterion for colloidality, and that consequently, any substance, irrespective of its chemical constitution, may exist in the colloidal state. It is even possible to have colloidal crystals, and Scherrer demonstrated by x-ray analysis that colloidal gold particles at the lower ranges of the colloidal dimensions are crystalline.

As particles become smaller and smaller, the Brownian motion, just noticeable at the lower microscopic limits, increases very greatly in speed and

amplitude; for kinetic motion depends (among other factors) on the mass; and, assuming spherical shape for convenience of calculation, the *mass* varies inversely as the *cube* of the diameter of the particle if no change in specific gravity accompanies dispersion. On the other hand, the *surface* of the particles varies inversely with the *square* of their diameters. The subjoined diagram indicates that in passing downward through the colloidal zone, we go from a condition where kinetic motion is relatively negligible as compared with the specific surface (that is, free surface per unit of weight), to a condition where the kinetic motion is of great importance, despite the large increase in specific surface. There thus naturally arises a *zone of maximum colloidality*, wherein the consequences of specific surface become most manifest before the consequences of kinetic motion become dominant. For example, maximum hardness in steel corresponds, approximately, to a colloidal dispersion of the iron carbide (cementite) in the iron. Both 5 per cent. starch suspensions and dextrose solutions show but slight increase in viscosity over water, whereas 5 per cent. starch colloidally dispersed, *e.g.*, by boiling, is very viscous. The importance of the zone of maximum colloidality in biology and medicine has been stated thus:[1]

> **A most striking example of optimum dispersion is found in living matter. Figuratively speaking, if all the chemical substances comprising our organism were in true or crystalloid dispersion, reactions would proceed so rapidly that we would, so to say, live ten years in ten minutes. On the other hand, if coarse dispersion prevailed, it would take ten years to live ten minutes. Every organism is dependent upon the coordination of its chemical reactions *in point of time*, and this leisurely procedure depends largely upon *degree of dispersion*, which keeps chemical reaction velocities within certain speed limits through its regulation of free surface and kinetic activity. Life lies between lysis and coagulation. The colloidal zone is, as it were, a vital metronome, tolling off the tempo of life.**

The extensive literature of colloid chemistry shows how large a number of factors influence the behavior of colloid particles, apart from the important one of size. For example, though for convenience we assume the particles to be spherical, they might have shapes widely differing from spheres. The specific gravity, chemical specificity and electric charge of particles and the nature of the medium in which they are dispersed are all of importance in determining their behavior. This literature also shows how wide-spread and important is the colloidal state on our relatively minute earth. It is only natural that we should expect to find instances of colloidal dispersion throughout the immensity of space, that is, in the field of astronomy.

An outstanding instance of the zone of maximum colloidality appears in the case of comets, whose nuclei, comas, and tails consist in part of colloidal matter. In 1870 J. Clerk Maxwell pointed out that the intensity of action of the sun's rays on a particle is in proportion to the particle surface which varies as the *square* of the particle diameter, whereas the gravitational pull of the sun on the particle varies as its mass which is proportional to the *cube* of its diameter. Theoretically, with particles having the density of water, the repulsion due to "light pressure" balances the solar attraction due to gravitation when the particles have a diameter of 0.0015 mm (1.5 μ). As particle size diminishes, the repulsive force gains domination over gravity, reaching a maximum and again diminishing, until with particles having a diameter of only 0.00007 mm (70 mμ) the two forces once more balance each other. These limiting dimensions must be still further reduced in the case of particles denser than water, so that it would appear that the sun selectively repels colloidal particles to form cometary tails, which, as spectroscopic observations indicate, shine mainly by reflected sunlight. The comet's tail is, therefore, an extremely tenuous celestial camouflage, a vast Faraday-Tyndall effect, analogous to what a searchlight beam shows in a foggy or dusty atmosphere. The earth recently passed through a comet's tail without appreciable effect, although yellow journals prophesied dire consequences and members of a certain sect gathered in church to await the impending "end of the world" and last judgment.

According to calculations by Schwarzschild, the effects of light-pressure are insignificant on particles having the dimensions of gas molecules, when compared with the effect of gravity. More recently, P. Debye[2] confirmed Schwarzschild's conclusions by making an extensive re-analysis of this problem, basing his calculations on the classical radiation theory and upon the electron theory of Lorenz. This indicates that colloidal particles are selectively repelled by the sun, both larger masses and gases tending to be attracted. Most comet's tails show the spectra of nitrogen and of carbon monoxide, while cyanogen and carbon do not appear to extend much beyond the cometary head. We know little of the formation and stability of chemical compounds under the conditions of temperature and of electronic and mechanical turmoil which prevail when a comet approaches the sun and develops a tail; but we do know that colloidal "smokes" tend to "hold" gases and were, in fact, used for this purpose to "carry" gases during the world war.

Though very exceptional, heliocentric tails, that is,

[1] Jerome Alexander, "Colloid Chemistry, Theoretical and Applied," Vol. I, p. 25. Chemical Catalog Company, 1926.

[2] *Ann. der Physik.*, 30: 57–136, 1909.

tails pointing toward the sun, are known and, according to Professor N. T. Bobrovnikoff (Ohio Wesleyan University), were seen in Comets 1844 III, 1862 III and 1882 II. Such tails might consist of particles larger or smaller than colloidal dimensions, and in the former case would support the view of Bredichin that they are responsible for meteoric showers.

Matter in colloidal dispersion also finds place in the planetesimal hypothesis advanced by T. C. Chamberlin and F. R. Moulton to account for the formation of the solar system. According to this hypothesis, which finds wide acceptance, about ten or twenty billion years ago a star approached our sun closely enough to tear loose and send whirling through space a small percentage of the sun's mass. No direct "side-swiping" was needed, for the nearest approach of the visiting star may have been of the order of the earth's distance from the sun; but the enormous gravitational fields probably caused explosive or pulsating ejection of matter from both sun and star. Part of this fell back into the sun, part was carried off by the visitor as it departed after a "visit" of several months, and part, estimated as about one seventh of one per cent. of the total solar mass remained swirling about the sun in the direction of the visitor's exit, and irregularly distributed because of the explosive and pulsating nature of its ejection. This accounts for the more or less orderly spacing of the planets, for their uneven sizes, as well as for the fact that they all rotate in one direction and approximately in the same plane. The retrograde moon of the large planet Jupiter seems to represent a "capture," possibly a small comet, a large meteorite or other invader.

The ejected matter was probably initially gaseous for the most part, but as it cooled it condensed into larger and larger particles, which then accumulated into planets and satellites under the action of localized gravitational forces. In passing from gaseous to microscopic dispersion the colloidal zone must be traversed, and frequently colloidal particles persist indefinitely. So-called "cosmic dust" appears to be of such nature, and the enormous "dark nebulae" appear to consist of vast clouds containing colloidally dispersed matter, which, by obscuring the light of exterior bodies and systems, make the so-called "coal holes" which astronomers find in the heavens. Enormous amounts of finely dispersed matter are still being gathered in by the gravitational pull of the sun and the planets. The study of radioactive phenomena has so enlarged our notions of time that according to Professor F. K. Morris the Cenozoic period is pushed back to at least 50 million years ago, while our oldest visible rocks go back about to 1,500 million years.*

* See also H. N. Russell, SCIENCE, 92: 19 (July 12, 1940).

The solar corona, in its outer ranges, may have colloidally aggregated matter of evanescent life, and according to Professor H. N. Russell the galactic nebulae also contain colloidal material, although the brighter spiral nebulae, which are at much vaster distances, consist of aggregations of stars.

The zodiacal light may represent an aftermath of the birth of the solar system, for it consists of a cloud of tenuous matter shining by reflected solar light. Saturn's rings appear to be more concentrated, for they cast shadows and their solid content is estimated to be 2 to 3 per cent. of their volume. But the constant attrition of solid chunks in Saturn's rings, in cometary heads, as well as the occasional collision of bodies in space and the aggregation of radiated matter, all furnish renewed supplies of finely dispersed material. Colloidal particles must appear and must be given consideration. Colloidal dispersions of matter in the aether of space have been termed *aethersols,* in contra-distinction to colloidal dispersions in our atmosphere which are known as *aerosols.* Apart from their importance in meteorology, aerosols are of considerable military and commercial significance.[3]

From the standpoint of meteorology aerosols fall into two groups: *organic* material, such as bacteria, spores, pollen and vegetable fragments; *inorganic* material, such as water and ice, rock and soil particles, volcanic ash, meteoric and cosmic dust, salts from drying of sea-spray, and hydrated nuclei of various chemical compounds like nitric oxide, ammonia, hydrogen peroxide, sulphurous and sulphuric acid, which may be formed in the atmosphere by solar radiation, or by electric discharges, or else enter it as a consequence of combustion of fuel. The ever recurring evaporation of water and its condensation through the colloidal zone into liquid or solid form, takes place on a gigantic and continuous scale.

According to Dr. W. J. Humphreys our atmosphere is coincident with the konisphere (dust sphere), and contains the following layers:[4]

(1) *Turbulence layer,* approximately one kilometer in height, which can often be seen from mountain tops as a haze with a more or less sharply defined upper surface.

(2) *Convection layer,* in which thermal convection is marked. "Its upper surface, often three kilometers, roughly, above the earth, frequently is a sharply horizoned ocean, as viewed from an aeroplane, in which cumulus clouds stand like islands in the sea."

(3) *Troposphere,* extending to the level of the highest clouds; in our latitude approximately 10 to 12 kilometers, though it tends to be higher in equatorial regions and lower toward the poles. Because of its great height its

[3] Jerome Alexander, *Popular Astronomy,* 33: No. 7, 1925.

[4] W. J. Humphreys, Alexander's "Colloid Chemistry, Theoretical and Applied," Vol. I, p. 424.

upper surface is seldom seen but is indicated by certain polarization phenomena of skylight. Into this tropic layer, vertical convection due to sudden temperature changes, sometimes brings terrestrial dust.

(4) *Stratosphere,* comprising everything above the tropic layer. Colloidal particles coming from the "daily millions of meteors," from hygroscopic nuclei, and from dust hurled to enormous heights by violent volcanic eruptions, supply nuclei for the highest cirrus clouds.

According to Dr. Humphreys, the weather records of the past three centuries show that cloudy and cool summers followed on explosive volcanic outbursts. In 1815 a great eruption of Tomboro (Sumbawa Island in the East Indies) killed 12,000 persons, and the next year (1816) is known as the "year without a summer," for there was snow in June and in August. The explosive eruption of Krakatoa (1889) traveled thrice around the earth according to barometric records, and for several years the high-flung dust caused "golden sunsets." The lava of the Tomboro eruption has been estimated at six cubic miles, whereas Professor Wilbur A. Nelson calculated that during the Cretaceous period a now extinct volcano in Kentucky spat up 50 cubic miles of lava, whose fall may be traced 800 miles north and south, and 450 miles east and west of the crater. We can readily understand how in ages of great volcanic activity the climates and rainfall throughout the earth must have been seriously affected, even to the extent of glaciation. In 1932 ash from Chilean volcanoes reached as far as Rio de Janeiro in four days, a distance of 1,800 miles, and marked weather disturbances were reported in Argentine.[5]

The quantities of dust carried by winds is much greater than most people would imagine. They are sufficient to delay the twilight, for example, at Assuan in upper Egypt, for about 45 minutes. In March, 1901, a cyclonic storm central over Tunis raised dusts from the Algerian deserts to such high levels that one third of the 1,800,000 tons that fell in Europe dropped north of the Alps. About 150,000,000 tons are estimated to have fallen on the African coast, and an unknown amount into the Mediterranean Sea. Dust storms in Peiping are notorious, the dust clogging fountain pens, obscuring printed pages and causing what is called "Peiping throat." In the spring of 1934 some 300,000,000 tons of earth were lifted from the drought-parched western states by a strong northwest wind and scattered over half of our country. The legendary "Sea of Darkness" lying between the Canary and Cape Verde Islands is accounted for by the dust falls from Sahara, common there between January and April.

The incidence of goiter and cretinism, mainly due to iodine deficiency, is highest in regions remote from the sea, where salt dust formed by the drying of ocean spray is less apt to reach soil and water, and furnish the small but essential traces needed for the formation of thyroxin in the thyroid gland. It would take a person about 1,000 years to drink enough of the water of Lake Superior to give him the necessary supply of iodine, so that we can understand the importance of the unseen colloidal salt particles in our atmosphere.[6]

Weather conditions are, to a large extent, determined by the nature of the dispersion of water in the atmosphere; and to a considerable degree, the presence of condensation nuclei control water dispersion, and local conditions lead to the formation of haze, mist, fog, rain, snow or hail. The high incidence of dense fogs in London is largely attributable to the presence of nuclei resulting from the burning of coal, etc. Professor Carl Barus[7] kept a continuous record of atmospheric nucleation for several years at Providence, R. I. He found that the number of nuclei varied from about 2,000 to 100,000 per cubic centimeter; and though it varied greatly during each day as well as from day to day, it was much greater, on the average, about the time of the winter solstice when most fuel is burned, and least about the summer solstice. The most effective nucleators are substances which produce highly dispersed, hygroscopic or soluble particles. If fog be formed on such nuclei and then evaporated, the hydrated nuclei persist and will determine fog formation without material supersaturation. The luminous "paths" whereby one follows the emission of radium "rays" consist of strings of tiny water droplets deposited on strings of ionized particles, so numerous as to appear to be a continuous line in the Wilson fog-chamber. Nuclei are produced in quantity by brush discharges and even by impinging water jets.

When air containing moisture is cooled, supersaturation occurs and the moisture tends to condense. For example, in Hawaii the warm moist trade winds, in rising to pass over the high mountains, are cooled by expansion as the pressure is thus reduced, and thick clouds and heavy rains occur in the mountain tops and higher valleys; but the clouds evaporate as they move on, over the crests. Showers from a cloudless sky, locally known as "liquid sunshine," occur when the wind is strong enough to blow the mountain rain into a cloudless area. This is common in Honolulu. Cloud streamers are common on very high mountain peaks, *e.g.,* the Matterhorn; and in 1936 a "plume" seven miles long was observed streaming from Mt. Everest. Similarly, in the arctic regions, despite the small moisture content of the air, the intense cold

[5] Jerome Alexander, "Colloid Chemistry," 4th ed., D. Van Nostrand Company, 1937.

[6] *Ibid.*

[7] Carl Barus, Alexander's "Colloid Chemistry, Theoretical and Applied," Vol. I, p. 420.

produces very curious phenomena. Thus Rear Admiral Richard E. Byrd reports that the small amount of moisture held by air at 50 degrees below zero (F.) forms a real fog when thrown out by mixture with colder air; and "when a man stood inside the entrance to one of the house tunnels, the vapor formed by his breathing was so heavy the house appeared to be on fire."[8]

The raindrops which determine the formation of rainbows are much larger than colloidal dimensions, and so, in most cases, are the tiny ice crystals which cause halos about the sun, rings about the moon and the numerous other allied phenomena known to meteorologists. However, in many cases colloidal dispersions form, even though they may have a transient existence. "Solar rainbows," often seen in the tropics and just recently seen here, are due to very high floating ice particles. Finely dispersed particles are responsible for the "blue" color seen in certain lakes and portions of the ocean, in highly dilute emulsions or suspensions (*e.g.*, of milk), in glacial streams and possibly in glaciers. In 1913 Professor W. H. Martin[9] carefully freed liquids and gases from dust and found that they would scatter light. This was direct experimental proof of the theory of Lord Rayleigh that the blue color of the sky is due to scattering of light by air molecules, which are, of course, much below colloidal dimensions. In nature, however, liquids and gases are always contaminated with dispersed impurities, and these often exert a marked effect. In the absence of atmospheric dust, night descends abruptly, in contrast to the delayed twilight before referred to.

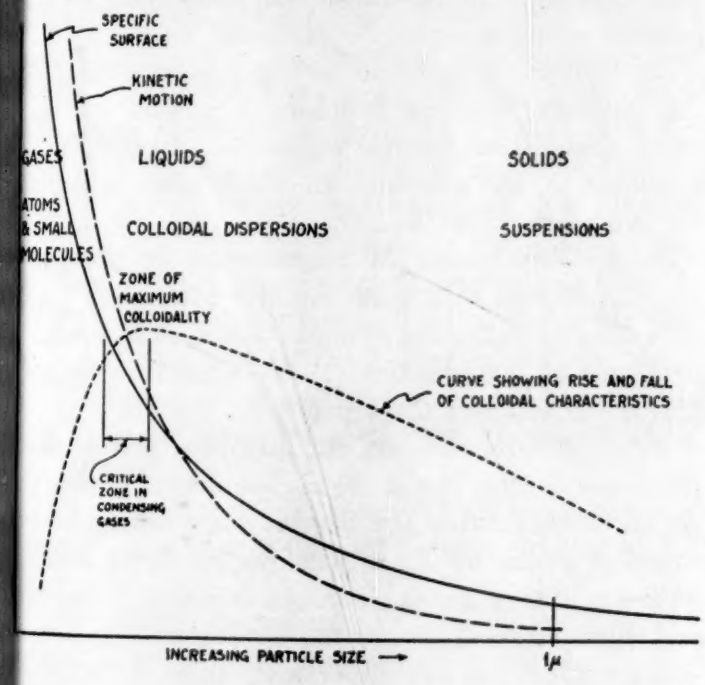

FIG. 1.

Colloidal haze causes a glare which prevents perception of distant detail, but which may be filtered out so that better vision is had through the long-wave fog-piercing portion of the spectrum. The use of neon lights for beacons, and infrared photography involve recognition of the fact that the amount of light scattered from its course is inversely proportional to the fourth power of its wave-length. Sunset and sunrise colors are mainly yellows and reds, whereas distant mountains often appear blue. In his story "Rip Van Winkle" Washington Irving refers to the fact that the appearance of the Catskill Mountain is a weather indicator to be relied on.

Clouds generally carry electric charges due to the capture of ions, electrons, surface electrification, etc. Since the charge is carried on the surface of the droplets, their aggregation, evidenced by development of a dark or livid shade, leads to very high voltages which can break down intervening resistance and form a lightning flash. In 1875 Gaston Planté produced globular brush discharges which sometimes formed wandering globular sparks. He pointed out that "ball lightning" involves the same principles, and stated: "Although an aqueous surface is not indispensable for forming luminous electric globules, since we have obtained them over a metallic surface, the presence of water, or of vapor from water, at least facilitates their formation or tends to give them more volume because of the gases furnished by the decomposition of water at high temperatures." J. C. Jensen recently reported that ball lightning occurs most frequently in connection with dust, *e.g.*, from a fire-place or in a squall or tornado. The explosive effects so often reported, seem to involve an oxyhydrogen explosion, which would be all the more violent if atomic hydrogen (Langumir) were first produced.[10]

Thomas Graham, F.R.S., the father of modern colloid chemistry, in commenting on the colloidal characters of ice at or near its melting point, points out that although ice formed at temperatures a few degrees under the freezing point has the well-marked crystalline structure seen in snow or hoar frost, ice formed in contact with water at 0 degrees C. is a plain homogeneous mass with a vitreous fracture, exhibiting no facets or angles. The beautiful crystals recently demonstrated in ice blocks by Sir William H. Bragg may, perhaps, be due to a molecular rearrangement, which Graham gives as an explanation of the observation of Mr. Persons that ice cooled below 0 degrees C gives off heat. After referring to Funke's "blood-crystals" which form in a highly colloidal material, Graham concludes: "Can any facts more strikingly illustrate the maxim that in nature there are no abrupt transitions, and that distinctions of class are never absolute?"

[8] Jerome Alexander, "Colloid Chemistry," 4th ed.

[9] W. H. Martin, Alexander's "Colloid Chemistry, Theoretical and Applied," Vol. I, p. 340.

[10] Jerome Alexander, "Colloid Chemistry," 4th ed.

OBITUARY

JAMES W. GLOVER

THE passing of James W. Glover, long identified in many ways with the University of Michigan, marks an era in American mathematics whose continuance gives promise to extend indefinitely into the future. Probably in a greater degree than to any other single individual, the present place of actuarial mathematics, with the mathematics of finance and of statistics, owes its prominence in American colleges to this Michigan man.

Under the stimulus of Dr. Glover's active interest, Michigan began in 1906 to give courses in the mathematics of finance and insurance. The peculiar merit of this development lies in the fact that the necessary mathematical courses supporting sound instruction in actuarial science were immediately developed at Michigan. Within a few years, so rapidly because of the multiplicity of insurance investigations in the public eye and mind at that time, students in large numbers desirous of serious preparation for the expanding insurance fields came to Michigan for instruction.

Even in the early period elementary statistical courses received some attention. However, a few years later with the arrival of Harry C. Carver (1916), further statistical courses and also casualty insurance courses were developed. This was made possible as the broad and scholarly foundation which had been prepared for the actuarial courses served also for the newer developments. In this program Professor Glover participated in every way.

As early as 1906 Dr. Glover was appointed as consulting actuary to the Wisconsin Legislative Investigation Committee, continuing in Wisconsin the following year with the Joint Committee on Banks and Insurance. In 1896 the Canadian Royal Commission on Insurance summoned Professor Glover as expert. The National Government employed the Michigan teacher as expert special agent in the U. S. Census Bureau (1910), where he served many years, editing United States Life Tables of 1890, 1901, 1910 and 1901–10, published by the Government Printing Office. Such books are equivalent in circulation, often, to "best sellers." Connections Professor Glover had also with the Departments of Agriculture and Labor and the Treasury (Advisory Board, War Risk Insurance).

The State of Michigan and the university both called frequently upon their expert for his technical assistance. Both the Michigan Teachers' Retirement Fund and the favorable provisions made by the regents of the university for faculty retirement owe much to the activity of Michigan's actuarial department.

This type of service in the public interest so well represented by the life of James W. Glover indicates, in a way, the most vital success of a professor in a state university. Instruction is, of course, the primary public service, but a state employee is obligated to direct his activities to protecting the public interest in other ways when possible.

For many years examinations for admission to the actuarial societies were held in Ann Arbor. This was but one piece of evidence of the large and important group of Michigan-trained members. Upon the retirement of Professor Glover, at seventy as required at Michigan, these national societies tendered a testimonial dinner in Chicago given by Glover's former students. Some two hundred, including many executives of major companies, attended.

A fellowship in insurance was established at this meeting in the name of the Michigan teacher.

Dr. Glover's long connection as trustee, elected by the members, with the Teachers' Insurance and Annuity Association culminated in his appointment as president of the company, in which office he served for two years, 1930–1932.

In the department of mathematics at Michigan, Dr. Glover rose with some rapidity after eight years of service as instructor in mathematics, to the rank of professor of mathematics (1911–1938), later serving also as chairman of the department.

As a teacher and as an administrator at Michigan, Professor Glover was in the highest degree successful. As an administrator Dr. Glover was quick to follow words of praise by action with respect to the budget. In the matter of books, journals, technical equipment and even research assistants, Professor Glover was ever quick to seize any opportunity to be of service to the men at Michigan. The men brought into the department during this period were selected with great care for their academic promise, which has in extraordinary measure been justified by their subsequent publications.

In 1900 Dr. Glover married Miss Alice Durfee Webber, of Ann Arbor, who, with the son, James W. Glover, born in 1901, survives him.

Undoubtedly the most important literary activity of Professor Glover was that in connection with the U. S. Census Life Tables (1890, 1901, 1910 and 1901–1910), published in Washington. In addition to many articles, Professor Glover (with Harry C. Carver) in 1921 issued tables of compound interest functions, still published by George Wahr in Ann Arbor. A number of other important sets of tables and statistics followed upon this. In 1935 (with Walter O. Menge) was published the "Mathematics of Life Insurance" (Macmillan Company).

Such is the record of an active life, enriched by

many enduring friendships, covering many important developments in America's mathematical history, in the formative days of fields now of the utmost importance.

LOUIS C. KARPINSKI

SCIENTIFIC EVENTS

THE FEDERAL DEPARTMENT OF HEALTH OF BRAZIL

THE correspondent of the *Journal* of the American Medical Association at Rio de Janeiro writes: "President Getulio Vargas has signed a decree reorganizing the national department of health. This reorganization and enlargement emphasize the interest that the present government has taken in problems relating to public welfare and gives to the federal bureau of health a status near that of a ministry. All activities related to problems of health under the federal government, with the exception of those concerning the child, have been consolidated under a general director in the Ministry of Education and Health. Even the well-known Oswaldo Cruz Institute, which previously enjoyed the position of an independent institution of research and study in the general field of experimental medicine, has been included in the new organization. The decree states that the national department of health will promote surveys, research relating to health, sanitation and hygiene, the epidemiology of diseases and the methods of their control and treatment and will directly administer the activities connected with these problems and others related to health.

"Dr. J. de Barros Barreto, an able sanitarian and executive, has been appointed director general of the department.

"The national department of health is composed of several divisions: the division of public health organization, which cooperates with the states and counties to create and conduct local health units; the division of hospitals, which is intended to foster throughout the country the creation and improvement of hospitals, a matter in which Brazil is well below her necessities, and the division of tuberculosis and the division of leprosy. The federal government has already appropriated and paid to more than twelve of the twenty states of Brazil the means to build and equip sanatoriums, preventoriums and leprosariums. The division of yellow fever includes the well-known organization developed with the cooperation of the International Health Board of the Rockefeller Foundation. The work against Aedes in the cities, which have been practically free of the disease for several years, and the work against 'jungle yellow fever,' still prevailing in many rural communities, including the extensive use of viscerotomy and vaccination, is already being performed by Brazilian personnel. The Rockefeller Foundation conducts the Yellow Fever Laboratory, built within the premises of the Oswaldo Cruz Institute, where research is carried on and the vaccine is prepared. The division of malaria is expected to expand the antimalarial work. The Federal Bureau of Health was already doing the work against malaria, especially in the Federal District (suburbs of Rio de Janiero City), in the neighboring state of Rio de Janeiro and in the Gambia infected northeast area (states of Ceara and Rio Grande do Norte), the latter area where the Rockefeller Foundation has cooperated extensively. Other divisions are devoted to mental diseases, health education, plague, vital statistics, maritime quarantine and the licensing of drugs.

"Among the new functions of the Oswaldo Cruz Institute is the education of public health medical specialists, as the course in hygiene and public health has been transferred from the medical school of the University of Rio de Janeiro to the institute."

GRANTS OF THE GEOLOGICAL SOCIETY OF AMERICA

AMONG the grants authorized in May by the council of the Geological Society of America are the following:

General, Geomorphology and Stratigraphy—$3,624.50.

Fritiof M. Fryxell, Augustana College, will spend ten weeks, with Leland Horberg, University of Illinois, and two assistants, studying the structure, erosional history and glacial geology of the Teton Range, Wyoming. $440.

Lewis B. Kellum, University of Michigan, will return to northern Mexico to complete the mapping of Sierra de Tlahualilo and Sierra del Rosario in further study of the Coahuila Peninsula and the position of the continental margin in Mesozoic time. The University of Michigan will contribute an equal sum. $2,000.

L. L. Ray, Michigan State College, and J. Fred Smith, Jr., Texas Agricultural and Mechanical College, will spend ten weeks mapping the geology of the Cimarron Range, New Mexico, in continuation of their study of the structure, physiography and geologic history of the Sangre de Cristo Mountains. $525.

H. T. U. Smith, University of Kansas, will study periglacial phenomena, particularly those related to intensified frost action, in the Blue Mounds, Baraboo and Trempealeau regions of the Driftless Area of Wisconsin. $87.

Arthur N. Strahler, Columbia University, will spend six weeks in the east Kaibab monocline and adjacent parts of the Grand Canyon region completing a study of the geomorphic history of the region in which in 1939 and 1940 he had assisted Donald L. Babenroth, deceased. $287.50.

J. Stewart Williams, Utah State Agricultural College,

will spend three months correlating the Carboniferous rocks of the Wasatch with those of the Uinta Mountains and those of southeastern Idaho. $285.

Geochemistry—$8,450.

Esper S. Larsen, Harvard University, will continue with the spectrographic determination of the rarer elements in groups of rocks from petrographic provinces. This work was begun under a previous grant from the society. $2,250.

W. J. Mead, the Massachusetts Institute of Technology, in cooperation with Robley D. Evans, directing the work of Clark Goodman and Patrick Hurley, will conclude the investigation of the determination of the age of rocks by the helium method. $6,000.

O. B. Muench, New Mexico Highlands University, will continue his investigation of the age of rocks and minerals by lead-uranium method by careful analysis of the minerals for lead, uranium and thorium. $200.

Geophysics—$3,400.

Rev. Daniel Linehan, S.J., Weston College, Massachusetts, will conduct a series of seismic surveys in the Triassic formations of the Connecticut Valley to determine their depths and the characteristics of the major faults. $400.

George P. Woollard, Princeton, N. J., is to make an areal gravitational and magnetic survey in the Atlantic Coastal Plain and Piedmont provinces from New Jersey at least through Virginia. Marked anomalies are known in the area, elevation data are largely available, and the geology is well enough known to play its vital role in interpretation. $3,000.

Glacial—$2,700.

J. Harlen Bretz and W. D. Jones, University of Chicago, will go to Alberta to map glacial moraines, correlate soil profiles with moraines and associated till sheets and study the relation of continental ice sheet moraines to the Cordilleran valley moraines in the latitude of Edmonton. $450.

Max Demorest, Yale University, will complete his program of laboratory research on the physics and deformation of ice. $100.

Hellmut de Terra, New School for Social Research, is to make a field study of late Quaternary glaciation in the Uinta Mountains in an effort to date certain Stone Age cultures discovered near Fort Bridger, Wyoming. $375.

Chauncey D. Holmes, University of Missouri, will devote eight weeks to mapping the boundary between the Nebraskan and Kansan drift sheets in Missouri. He will also endeavor to obtain data on direction of ice movement through study of preferred long-axis directions of embedded stones. $300.

Paul Mac Clintock, Princeton University, and Earl T. Apfel, Syracuse University, will work for ten weeks in the Salamanca re-entrant where the moraines of the Mississippi Valley region meet those of Pennsylvania and New Jersey. They are to correlate the Wisconsin drifts on the two sides of the re-entrant. $600.

Hakon Wadell, University of Chicago, will make a comprehensive survey of the esker problem. $600.

George W. White, University of New Hampshire, will study the drift border in eastern Ohio to determine whether there is more than one drift, the exact location of the drift limits and the mode of retreat of the last ice sheet. $275.

THE ANNUAL REPORT OF THE DIRECTOR OF FIELD MUSEUM OF NATURAL HISTORY

THE annual report of Dr. Clifford C. Gregg, director of Field Museum of Natural History, a book of more than 150 pages illustrated with ten collotype plates, appeared on August 6. The report is several months later than usual due to unusual conditions in the division of printing.

It is recorded that Marshall Field, a member of the board of trustees, made gifts to the museum amounting to $284,680. From Stanley Field, president of the museum, contributions totaling $22,700 were received. Mrs. James Nelson Raymond, founder of the James Nelson and Anna Louise Raymond Foundation for Public School and Children's Lectures, which provides special museum services, provided $6,000 to be used toward the operating expenses of the foundation. This foundation was established and endowed by Mrs. Raymond in 1925. Among other contributors are: Charles H. Schweppe, Chicago, $2,500; Mrs. Clarence C. Prentice, Chicago, $1,000; the Rockefeller Foundation, $1,000. Legacies received during the year include $10,000 from the late Frederick T. Haskell, and $8,000 from the late William B. Storey.

The General Electric X-ray Corporation, Chicago, presented to the museum an x-ray apparatus, fluoroscopic screens, mechanical devices for automatic control and timing and all other accessories for an exhibit in which an Egyptian mummy is shown intermittently with the projection of the x-ray image of its skeleton. Additions were made to the collection of Chinese ivory objects through a bequest of the late Louis L. Valentine. Large and unusual specimens of game fishes were presented by Michael Lerner, of New York.

In the introduction to his report, Major Gregg states:

> Again I am privileged to report substantial success in many lines of activity. Perhaps the principal emphasis has been placed upon the rehabilitation of the building itself. For several years financial conditions and the pressure of new construction and expansion have interfered to some extent with both ordinary and extraordinary maintenance of the splendid structure housing our collections. During the past year . . . necessary repairs have been made or are well under way.
>
> The principal exhibition feature of note was the opening of the new Hall of Babylonian Archeology bringing to a culmination the work of about seventeen years, beginning with the Field Museum-Oxford University Expedition to Kish (1923–33).

Museum attendance for the year was 1,450,685, exceeding the number of visitors in the previous year by more than 40,000. It is pointed out that extramural educational activities, conducted by the Raymond Foundation and the N. W. Harris Public School Extension, brought the total number directly reached by museum activities up to nearly 2,200,000. Millions of others received scientific information from the museum through indirect channels such as radio, publications and press reports.

Detailed reports are given of the activities of the four scientific departments—anthropology, botany, geology and zoology; and of all other divisions of the museum, educational, administrative, public service, maintenance, library, etc. The report contains also a complete membership list.

U. S. CIVIL SERVICE EXAMINATIONS

THE U. S. Civil Service Commission reports that the Government continues its search for specialists in all branches of industry and business. The Federal Civil Service examination for industrial specialist, announced on July 7, has been amended to remain open for receipt of applications until further notice. The National Defense Program needs men with experience in one or more of the following fields: Iron and steel, non-ferrous metals, machine tools, ordnance, aircraft, marine and automotive equipment, railroad repair shops, radio and other electrical equipment, supplies and apparatus, textiles, forest products, paper, printing and publishing, chemicals and allied products, plastics, petroleum and coal products, rubber products, stone, clay and glass products, leather and its manufactures and food and kindred products. Salaries range from $2,600 to $5,600 in the various grades. No written examination is given.

Those trained in engineering are again called upon for government service. An examination will be given for engineering aids in two fields: photogrammetry and topography. Salaries range from $1,620 to $2,600 a year. Persons are particularly needed in the three lower grades (paying $1,620 to $2,000) in the field of photogrammetry. A written test will not be given but competitors will be rated on their education and experience. Although the completion of 14 units of high-school study is a basic requirement, applicants may substitute an additional six months' engineering experience. In addition they must have had responsible civil engineering experience, including some work in the optional branch selected.

To secure economists in all branches of economics for government service the commission announces an examination for positions paying from $2,600 to $5,600 a year. Applications will be accepted until further notice and will be rated as soon as practicable after receipt. Those who filed applications for the general economist examination announced in September, 1940, and who received eligible ratings need not file another application. However, if they wish to apply for a higher position, they should file a new application. Superintendents of building maintenance are needed by the Federal Works Agency. Positions are to be filled in public housing projects and public buildings in various sections of the country. The salaries range from $2,600 to $3,800 a year. Applications must be filed not later than August 26, 1941. A written test will not be given, but applicants must show experience of the proper scope and responsibility. To qualify as junior superintendent ($2,600 a year) four years of experience is required; for the superintendent positions ($3,200 a year) six years; and for the senior superintendent ($3,800 a year) nine years. Applicants for these positions must not have passed their fifty-fifth birthday.

Further information and application forms for these examinations can be obtained at any first- or second-class post office or from the Civil Service Commission in Washington.

SCIENTIFIC NOTES AND NEWS

DR. GEORGE D. BIRKHOFF, Perkins professor of mathematics at Harvard University, has been elected an honorary member of the London Mathematical Society.

THE degree of doctor of science has been conferred by McMaster University, Hamilton, Ontario, on Dr. Donald Church Balfour, director of the Mayo Foundation and past-president of the American College of Surgeons.

THE honorary degree of doctor of science was awarded at the commencement exercises of the University of Maryland to Dr. Wortley F. Rudd, dean of the School of Pharmacy of the Medical College of Virginia.

SIR ROBERT ROBINSON, Waynflete professor of chemistry at the University of Oxford, was awarded on August 6 the first Paracelsus Gold Medal of the Swiss Society of Chemistry.

PROFESSOR EMIL ABDERHALDEN, professor of physiology in the University of Halle, has been made an honorary member of the Society of Physics and Natural History of Geneva.

Nature states that Griffith Brewer has been elected president of the Royal Aeronautical Society for the

year October, 1941–September, 1942; Professor L. Bairstow, W. C. Devereux and the Right Honorable J. T. C. Moore-Brabazon have been elected vice-presidents.

DR. ANDREW C. IVY, professor of physiology and pharmacology at the Medical School of Northwestern University, has been elected president of the Chicago Society for Internal Medicine.

DR. A. M. HARDING, professor of mathematics and astronomy at the University of Arkansas, became president of the university on July 1.

DR. BENNET M. ALLEN, professor of zoology at the University of California at Los Angeles, has been appointed acting dean of the Graduate Division. He will take the place of Dr. Vern O. Knudsen, who has been granted a leave of absence to assist in a national defense project. Dr. Knudsen's leave will continue until the end of December, and will probably be continued.

LAURENCE J. ACKERMAN, associate professor of insurance of the University of Newark, has been appointed dean of the School of Business at the University of Connecticut.

FREDERICK K. TEICHMANN, associate professor of aeronautical engineering, has been appointed acting director of the department of aeronautical engineering at New York University. He succeeds Dr. Alexander Klemin, formerly head of the Guggenheim School of Aeronautics, who last spring retired as director to become research professor of aeronautics.

AT the University of Minnesota Dr. Clarence M. Jackson, professor and head of the department of anatomy, who retired at the close of the academic year, has been appointed professor emeritus. A committee consisting of the following professors has been formed to administer the department for the coming year: Dr. Edward A. Boyden, chairman; Dr. Andrew T. Rasmussen and Dr. Hal Downey. Dr. C. D. Creevy has been promoted to a professorship of surgery. He has also been made chief of the division of urology and assistant dean of the Medical School; Dr. James A. Johnson has been appointed clinical professor of surgery.

DR. SAMUEL R. M. REYNOLDS, associate professor of physiology at the Long Island College of Medicine, has been appointed research associate of the Carnegie Institution of Washington, in the department of embryology, Baltimore. He will assume his duties there on September 1.

MORTIMER MENAKER, who was granted the Ph.D. degree in agricultural biochemistry at the Pennsylvania State College in August, has joined the research staff of the Fisher Scientific Company at Pittsburgh.

DR. ALBERT EDWIN SIDWELL, JR., has been named director of the Chemical Laboratory of the American Medical Association in Chicago, a unit of the Division of Drugs, Foods and Physical Therapy. He has been a chemist in the chemical laboratory since 1938.

RAYMOND G. BENDER has resigned his position as research chemist with the Borden Company, Research Division, Bainbridge, N. Y., to become chemist and plant manager of the Harris Laboratories, Tuckahoe, N. Y.

DR. GEORGE B. KISTIAKOWSKY, professor of physical chemistry at Harvard University, and Dr. Robert C. Elderfield, professor of organic chemistry at Columbia University, members of the National Defense Research Commission, who have been in England, arrived in New York on the American Clipper from Lisbon on August 4.

ACCORDING to the *British Medical Journal*, Dr. G. M. Findlay, of the Wellcome Research Institute of London, will direct the manufacture of yellow fever vaccine for the South African Institute for Medical Research in Johannesburg.

THE following pharmacologists are working at the California Medical School this summer: Dr. F. Luedena, of the University of Rosario, Argentina; Dr. Hamilton H. Anderson, of Peiping Union Medical College, China; Dr. S. A. Peoples, professor of pharmacology at the University of Alabama; Michael Shimkin, of the National Institute of Health, Washington, D. C., and Dr. P. K. Knofel, professor of pharmacology at the University of Louisville.

WITH reference to a note in SCIENCE for June 20, we learn from Dr. Frans Verdoorn, editor of *Chronica Botanica*, that Dr. L. G. M. Baas-Becking has been released by the German authorities and that he has assumed again the directorship of the Botanical Institute of the University of Leyden.

DR. WILLIAM DE B. MACNIDER, Kenan research professor of pharmacology at the Medical School of the University of North Carolina, delivered a series of three lectures on July 29, 30 and 31 on "Acquired Resistance of Tissue Cells," under the auspices of the department of materia medica and therapeutics of the Medical School of the University of Michigan. The subjects of his lectures were "The Repair of Tissue and Tissue Resistance," "The Ageing Process and Tissue Resistance" and "The Adjustability of the Life Process to Injurious Agents."

THE Pacific Coast Convention of the American Institute of Electrical Engineers will meet at the Yellowstone National Park on August 27, 28 and 29. Headquarters will be at the National Hotel.

THE eighth annual Metal Mining Convention and

Exposition of the American Mining Congress, Western Division, will be held at San Francisco from September 29 to October 2. The subject of the meeting will be "Metals for Defense." In addition to the program devoted to economic and operating subjects, there will be a display of machinery and supplies, covering all the material and equipment needs of the industry.

THE cornerstone of the new petroleum engineering building at the University of Texas, to be built at the cost of $200,000, has been laid. The formal dedication of the building will take place early this autumn.

ACCORDING to *Museum News* a new building is planned for the Army Medical Museum to replace the old brick structure at Seventh Street and Independence Avenue, Washington, D. C. Construction of the building was authorized by Congress in 1938 and the sum of $130,000 was appropriated for the preparation of plans, which have been drawn by Eggers and Higgins. The proposed building, which will be started as soon as funds are provided by the Congress, will cost about $3,750,000. It will be about 212 feet square in ground dimensions and will contain more than four million cubic feet of space. It will accommodate both the museum and the Army Medical Library.

THE Royal College of Surgeons, London, has received the sum of £40,000 from the Bernard Baron Trustees to endow a Bernard Baron research professorship at the college. A letter addressed to the president of the college by the trustees reads in part: "The scientific work which has formed such a notable part of the activities of the Royal College of Surgeons of England must and will continue. The trustees realize, however, that one of the essential sinews of your and their endeavor to benefit mankind is the provision of funds for the prosecution of research. They have therefore decided to make a gift of £40,000 for the endowment of a Bernard Baron Research Professorship at the Royal College of Surgeons, so that, whatever the difficulties with which the council may be faced in other directions, research will not suffer."

THE University of Sydney recently received a bequest of £60,000 for scientific research, general and unconditional, from the estate of the late Sir Hugh Denison.

IT is stated in *Nature* that the University of Oxford is making a grant to the Department of Chemistry to carry out a nutritional survey and a study of antiseptics in relation to burns.

THE Museum of Northern Arizona, Flagstaff, has begun an extensive program of geological research on fundamental problems relating to the Colorado Plateau area. Plans call for intensive and detailed studies to be conducted in several related fields, especially stratigraphy, structural geology and geomorphology. Work is already being conducted both by the museum staff members and by associates representing other institutions. The central location of the museum and its library and laboratory facilities favor it as a natural center for students interested in geological problems of northern Arizona.

IT is announced that *The American Journal of Cancer,* edited by Dr. Francis Carter Wood, is now discontinuing publication because of lack of funds. It is reported that on account of the war there has been a considerable loss owing to the discontinuance of many European subscribers. This loss has been made up hitherto by the Chemical Foundation, which, however, has also been suffering a shrinkage of funds as the result of the expiration of important patents. The *Journal,* which has been issued monthly, was founded ten years ago by the late Francis P. Garvan, president of the Chemical Foundation.

THE Office of Information of the U. S. Department of Agriculture has issued a new list of agricultural workers in the land-grant colleges and experiment stations, as MP 420. It can be obtained from the Division of Publications.

THE name of the department of zoology at the University of Texas has been changed to "department of zoology and physiology." Funds have been provided by the university for the development of a comprehensive graduate program in biophysics.

THROUGH the cooperation of three transportation companies, the Pan-American airways, the Delta Line of New Orleans, and a third company, which requested that its name be withheld, there have been established four fellowships at the Louisiana State University, by which four young men of the Latin American Republics will be provided with fees, maintenance at the university and transportation from and return home at the end of the session. Dr. Robert H. Bradbury has been appointed director of a Division of Latin American Relations. The following have received fellowships: Alberto Raja Gabaglia, of Rio de Janeiro; Luis Fernando Moore, of Buenos Aires; Jose Serrano Martinez, of Quito, and Hugo Perez de Leon, of Guatemala.

A DECREE issued by the Argentine Government forbids for ten years the hunting of certain wild birds and animals which live in the Andes Mountains. These include the condor and several species of deer, which are said to have diminished alarmingly.

R. S. HUDSON, British Minister of Agriculture, has announced the appointment of an Agricultural Improvement Council for England and Wales, to devise methods for seeing that promising results of research are brought as rapidly as possible into ordinary farming practice. The council will advise from time to time on agricultural problems that seem to need scientific investigation. It will consist of a chairman and twelve members, appointed for three years with the possibility of reappointment, and will include practical farmers as well as distinguished men of science.

THE Universities Bureau of the British Empire has announced the selection for the Rockefeller Foundation of medical studentships for the present year. These studentships have been awarded as the result of a grant by the Rockefeller Foundation of $100,000 to aid the training in their clinical years of British medical students at a time when they may be deprived of the usual facilities. The amount of each studentship will cover the cost of tuition and living for two or three years. Between 90 and 100 applications were received and nearly two thirds of the candidates were interviewed. The 26 students selected are being sent to 19 universities in the United States and Canada.

DISCUSSION

THE CULTIVATION OF COTTON BY PUEBLO INDIANS OF NEW MEXICO

COTTON was cultivated by many of the Indian pueblos of the Rio Grande valley before the days of Coronado (1540).[1] It was used in the manufacture of textiles and also for ceremonial purposes. But the cultivation of cotton, except for ritual use (twine for prayersticks; to be placed unspun on the top of dance masks, etc.) has long since been discontinued. Early reports of the U. S. Indian agents do not mention the cultivation of cotton at all.

Very little is known about the botanical nature of the cotton cultivated by the Rio Grande pueblos. F. L. Lewton speaks of a specimen received from Mrs. Mathilda C. Stevenson, Española, N. M., which, he says, appears to be *Gossypium hopi*.[2] Where and when the specimen was collected and where it was deposited, if preserved, are not known. Dr. Elsie Clews Parsons reports that cotton is still cultivated at Jemez[3] and at Isleta,[4] but so far no report on identification of specimens from these pueblos has appeared.

In August, 1934, the writer collected a specimen of cotton from a garden at Ranchitos, the farming community of the Santa Ana Pueblo Indians which is located on the east bank of the Rio Grande just north of Bernalillo. Mr. Volney H. Jones, ethnobotanist in the Museum of Anthropology, University of Michigan, identified it tentatively as *Gossypium hopi* Lewton. The specimen has been deposited in the collections in Mr. Jones's custody (Catalog No. 14695). Late in the summer of 1936, Mr. Jones saw cotton under cultivation at Ranchitos and collected seeds. These seeds, together with those collected by the writer, were sent to the U. S. Department of Agriculture Field Station at Sacaton, Arizona, where plants from them have been grown annually since 1936.

R. H. Peebles, of the Field Station, who has examined these plants, reports, in correspondence, that this cotton, while quite variable, is similar to *G. hopi* in several taxonomically important respects. It is adapted to early flowering and fruiting, as is Hopi cotton. On the other hand, he notes that in certain characteristics the Santa Ana cotton diverges from *G. hopi,* and suggests affinity to Upland cotton (*G. hirsutum*). His conclusion is, however, that the "Santa Ana material is more closely related to *Gossypium hopi* Lewton than to *G. hirsutum* L."[5]

The following conclusions seem warranted: (1) The Santa Ana cotton and Hopi cotton have a common origin, that the cotton cultivated at Santa Ana to-day is a relic of aboriginal agriculture rather than a recent introduction from the cotton growing states of the Gulf coast region. (2) The minor differences in the morphology of these two (Hopi and Santa Ana) cottons are explainable in terms of differences in environment and, perhaps, differences in manner of cultivation (irrigation). (3) With regard to diffusion, the direction seems to have been from the Hopi country to the Rio Grande, rather than the reverse, since both cottons are adapted to a very short growing season and because the growing season at Santa Ana (196 days) is considerably longer than in the Hopi country (135 days). Our Santa Ana specimen is the only authentic and completely documented identification of cultivated cotton from an Indian pueblo in the Rio Grande region that has yet been reported, so far as we know.

LESLIE A. WHITE

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[1] See V. H. Jones's exhaustive "A Summary of Data on Aboriginal Cotton of the Southwest" in "Symposium on Prehistoric Agriculture" (*The University of New Mexico Bulletin,* 1936).

[2] "The Cotton of the Hopi Indians: a New Species of Gossypium" (Smithsonian Miscellaneous Collections, Vol. 60, No. 6; 1912).

[3] "The Pueblo of Jemez," p. 14, 1925.

[4] "Isleta, New Mexico," p. 211, 1932.

[5] I am greatly indebted to Mr. Peebles and to Mr. Jones for their kindness and cooperation in this matter.

THE PRESERVATION OF NATURAL AREAS EXEMPLIFYING VEGETATION TYPES

DR. VAN NAME'S specific criticism of the United States Forest Service in the third and fourth paragraphs of his discussion, "Need for the Preservation of Natural Areas Exemplifying Vegetation Types" in SCIENCE of May 2, 1941, page 423, and in his reply to Dr. Baldwin, SCIENCE, July 18, is both inaccurate and unjust. Many of his statements are easily refutable by any one willing to make a fair and impartial examination of the facts.

Directly contrary to the statement which Van Name makes, the so-called "primitive areas" which the Forest Service has established do not have to "first pass a searching test for absolute commercial worthlessness before selection"; neither are they "nearly or quite treeless." The National Forest wilderness, primitive and roadless areas, which are now generally referred to as wilderness areas, were set aside to preserve primitive conditions of transportation and habitation in which the works of man would not intrude upon those desiring wilderness recreation. In accordance with good land use planning practice these areas, it is true, are largely in the high back country and care was taken to choose areas with no outstanding commercial values, but the areas do include millions of acres of timber land of all age classes and of many species and types. A considerable portion of this timber is mature and over-mature virgin stands, the low commercial value of which is the result of inaccessibility, not the condition or size of the timber, because much of it would be of great commercial value if it were more accessible. From a scientific standpoint, it does not appear that the low commercial value of this timber is any drawback since it is just as valuable for ecological study purposes as though it were worth $10.00 per thousand board feet. National Forest Wilderness areas number 70 and include 14,000,000 acres, a very appreciable acreage certainly not indicative of lack of interest. A list of these areas and a map showing their location was published in *The Living Age* for July, 1940 (Vol. 5, No. 5).

More important from the standpoint of preserving natural areas exemplifying vegetation types, the point with which Van Name is primarily concerned, are the 41 natural areas on the National Forests, containing approximately 50,000 acres. Representatives of over 20 major forest types are included in this series. These areas are specially reserved to preserve permanently in an unmodified condition areas representative of the virgin growth of each forest or range type within each forest region so far as they are represented within the National Forests, to the end that its characteristic plant and animal life and soil conditions, the factors influencing its biological complex, shall continue to be available for purposes of science, research and education.

The existence of these areas and the more than ten-year-old policy under which they have been established directly contradict Van Name's assertion that the United States Forest Service has failed to recognize its obligation to the American public in setting aside such areas. Although set aside to preserve for scientific study typical examples of major vegetative types, particularly timber, in a virgin or as near virgin condition as can be obtained, and not necessarily to preserve merely areas of large trees or high scenic value, these natural areas do contain magnificent examples of big trees and mature or over-mature stands of high scenic and inspirational value. A list of these natural areas will appear in an early number of *Ecology*.

As the writer stated last December, in a report before a joint meeting of the Committee for the Study of Plant and Animal Communities, and the Committee for the Preservation of Natural Conditions of the Ecological Society of America, at Philadelphia, the Forest Service does not consider the present system of natural areas within the National Forests as complete, and additional ones will be added. Suggestions from ecologists and other competent individuals and organizations as to desirable areas and types of vegetation needed for completeness will be welcomed. Nevertheless, the Forest Service does feel that the set of natural areas mentioned above, probably the largest by far set aside by any one organization with the primary purpose of preserving natural vegetation for scientific study, is a forward step which, incomplete though it may be, deserves the understanding and support of scientists, particularly ecologists.

I. T. HAIG

U. S. FOREST SERVICE

MAN'S BIOLOGICAL OUTLOOK

IN recent issues of SCIENCE, Professor Eliot Blackwelder (April 18, 1941, pp. 364–366) and Professor H. D. Goodale (June 27, 1941, p. 618) have discussed the subject of man's probable future as a mammalian species. Professor Blackwelder asks the question (p. 366) ". . . will his [future man's] life and conduct be controlled by his intellect rather than by his feelings?" and Professor Goodale replies that recent work on animal and plant improvement "demonstrates that man holds his biological destiny in his own hands."

Neither of these writers, however, gives consideration to three factors in the problem of man's racial future that may be the most vital of all, namely (1) that man, physically and considered as a mammalian

species or genus, is one of the few living giants in the extensive group of mammals (Primates) to which he belongs, (2) that man's physical structure, both skeletal and visceral, has numerous well-known and much-discussed peculiarities that, like his gigantism, show him to be far advanced in the period of "phylogeronty" or racial old age, while (3), in his mental constitution man unites the dominating type of social behavior that is common to most anthropoid primates (well described by Yerkes and his associates) with such a unique genius for "implementing" it as to make the combination a totally new phenomenon in animal evolution. This combination may well prove to be, in the end, as racially lethal as the huge size and great bodily specialization of titanotheres, proboscidians and dinosaurs appears to have been in the past.

Though the idea of racial death as the normal end of every evolutionary line is not a new one, it is seldom given the place it deserves in the discussion of man's future. Professor Blackwelder alludes to it (p. 365), but Professor Goodale is silent on the subject. As an exception to this rule I may quote from an article entitled "A Palaeontologist Looks at Life," by Professor Herbert Leader Hawkins:

> . . . The conclusion seems inevitable that simplicity is safe and complexity is dangerous. But if the main tendency of evolution is toward specialization then evolution leads inevitably to extinction. The rates of progress may vary, but the destination is the same. . . . And yet there is nothing strange in the contention . . . are we not aware that we [as individuals] are living in the constant anticipation of death sooner or later?[1]

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THE LAW OF URBAN CONCENTRATION

ON page 19 of the July 4th issue of SCIENCE, E. L. Thorndike, in reviewing G. K. Zipf's book on "National Unity and Disunity," referring to his discovery of the law of urban concentration, remarks, "This discovery may rank with Quetelet's discovery that the statures of men are distributed in accordance with the so-called normal probability curve."

This discovery is neither new, nor perhaps quite as striking as Professor Thorndike seems to indicate. That the size of cities and their rank when plotted on doubly logarithmic paper form essentially a straight line, seems to be first indicated by F. Auerbach, and was shown to apply to the cities of the United States in my book, "Elements of Physical Biology," 1925, pages 306–307. That a relation of this sort is not uncommon is a well-known fact, the outstanding example perhaps being Pareto's law of the frequency distribution of incomes. Another example is Williss's "Theory of Age and Area," as applied to the frequency of biological genera and species (see *loc. cit.*, pages 311, *et seq.*). Still another example is the Frequency Distribution of Scientific Productivity, as shown by me in the *Journal* of the Washington Academy of Sciences, 1926, Vol. 16, page 317. From this last source, I may quote the following sentence (page 323): "Frequency distributions of this general type have a wide range of applicability to a variety of phenomena, and the mere form of such a distribution throws little or no light on the underlying physical relations." This type of frequency distribution is, in fact, Pearson's type XI, a special case of type VI.

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DR. LOTKA is right in giving to Auerbach the credit that I gave to Zipf; and I apologize for my ignorance of Lotka's discussions of curves which use ranks and are based on the extreme value of the series. Very likely he is right also in regarding them as relatively unimportant cases of curves of extreme skew, but I still hope that they will be more than that.

E. L. THORNDIKE

SCIENTIFIC BOOKS

ENDOCRINOLOGY

Endocrinology. The Glands and Their Functions. By R. G. HOSKINS, M.D. 388 pp. New York: W. W. Norton and Co. 1941. $4.00.

AMONG the many notable advances in the field of the biological sciences in the last fifty years none has been more spectacular than that relating to the endocrine glands. Unfortunately, much that has been written concerning these organs reflects more the enthusiasm of the investigator than it contributes to the advancement of knowledge, and this has been particularly true in the field of clinical endocrinology.

While the remarkable effects of small quantities of certain hormones upon bodily function are a continued source of wonder, a full appreciation of their action is not gained unless the function of the endocrine glands is projected against the operation of the organism as a whole. Until it was clearly recognized that the endocrine glands operate as an integrated system, largely controlled by the anterior pituitary, there was a tendency to believe that they possessed an autonomy of action that set each individual member apart from the others. Even more deplorable was the undue emphasis placed on the hormone as an entity without recognizing that the tissue or tissues upon which it acts

[1] *Proc. Cottswold Naturalist's Field Club*, vol. 33, pt. 3, p. 223, 1929, December, 1930.

form the second component by which endocrine activity is expressed.

The story of the endocrine glands has a close parallel with that of the vitamins. First, the recognition of the effects of deficiency, then the preparation of extracts that repaired the deficiency; then the isolation (and synthesis) of the active principle; and finally, in the case of vitamins but not yet in the case of the hormones, the identification of the cellular mechanism of which the active principle formed an essential part.

In the present volume the author has attempted the large task of writing a book that covers not only the fundamental knowledge of the endocrine glands as gathered by the experimentalist, but has also endeavored to point out the main clinical features of endocrine disorders in man. These, in themselves, would furnish material for a volume many times this size, but this book, in addition, deals in an interesting manner with the biological and teleological significance of these organs. As may be imagined, there is ample room for criticism on the grounds of omission and condensation of what may be regarded by some as essential material, but such criticism should be tempered by the avowed purpose of the book. It has been written for an audience as broad as its subject matter, "biologists, psychologists, premedical students, physicians and the intelligent general reader." Viewed in this light the author has produced a successful volume, one, indeed, that could have been written by few men and held such a universal appeal.

Dr. Hoskins may be termed one of the "pioneers" in the field of endocrinology in this country. He has seen the subject grow from the sincere efforts of a small group of men to place the study of the endocrine organs on a sound scientific basis to the honorable status it now holds as an important field in the biological sciences. He was one of the founders of the Association for the Study of Internal Secretions and the editor of *Endocrinology* for a long period of years. More recently, he has been the director of the Memorial Foundation for Neuro-Endocrine Research, another borderline field in which hardly the preface has yet been written.

In structure, the book takes up the endocrine glands in turn and after a brief historical outline discusses the work that led to the recognition of each as an organ of internal secretion. The isolation of the active principle, where this has been accomplished, is reviewed, however, with a minimum of the chemistry related to the details of the isolation or the identification of the active principle. The main physiological facts are usually given in good detail, and this is followed by a description of the principal clinical syndromes associated with hypo- or hyperfunction of the organ in man.

To many the last two chapters on "Some General Aspects of Endocrinology" and "Endocrinology of the Future" will prove of especial interest. Here the author gives us his philosophical approach to the problem and outlines the major fields in which he anticipates future work will be done. Such chapters are not usually found in more formal text-books on the subject, but in this volume they are in keeping with the purpose for which it was written and for the audience it is intended.

Those with expert knowledge will find many places in the book that are lacking in detail, and in practically no instance will there be found detailed information of the experiments cited. However, these must be sought in the original articles, of which several of the most important are cited either at the end of each chapter or in the suggestions for further reading at the end of the book.

The reviewer, however, feels he must call attention to one gross contradiction. On page 180 it is clearly stated that the anterior pituitary hormones are of a protein character and are therefore destroyed by the digestive juices. Nevertheless, on page 173 there is reproduced the height and weight curve of a dwarf whose growth was alleged to be accelerated by the administration by mouth of anterior lobe substance. True, no comment is made in the text on the validity of these observations, but this chart does mar what is generally a conservative view of the value of this type of replacement therapy.

In conclusion, the author has succeeded in preparing a book that is eminently suitable for those who wish to obtain a broad picture of the development, present status and future possibilities of endocrinology, and he is to be congratulated on compressing so much readable material into such a small yet well-rounded volume.

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THE THEORY OF NEWTONIAN ATTRACTION

An Introduction to the Theory of Newtonian Attraction. By A. S. RAMSEY. ix + 184 pp. Cambridge University Press. 1940.

THIS is a book of simple text, with many problems of practical interest to the student of applied mathematics. On the one hand it is a good preparation for Kellogg's "Foundations of Potential Theory," which is more precise and much more extensive on the theoretical side, and on the other, for the rich and systematic collection of problems in the Newtonian

Potential Function of B. O. Peirce, which many of us remember as young students. Ramsey's "Introduction" can be read profitably by persons who have mastered the second year of calculus in an American university.

The reviewer does not mean to say that the book is a mere routine selection of details of subject matter from more ambitious treatises. For example, the following topics will immediately excite interest: the condition that a family of surfaces be a possible family of equipotential surfaces; approximate formulae for the potential of a body at large distances from it in terms of the principal moments of inertia, and the potential of a nearly spherical body, with applications to the attraction of the moon on the earth; the equilibrium of a rotating liquid, with Jacobi's ellipsoid of three unequal axes. The reader can thus expect to gain an introduction to several of the classical problems connected with the subject, as well as some systematic knowledge of the subject itself, in this very brief exposition.

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SOCIETIES AND MEETINGS

THE AMERICAN ASSOCIATION OF BOTANICAL GARDENS AND ARBORETUMS

AT the annual meeting of the American Institute of Park Executives, in September, 1940, a new organization was formed, to be made up of those connected with arboretums and botanical gardens situated in North America. Though this organization is still very young, it has at present approximately seventy members, representing approximately fifty-four different arboretums and botanical gardens in North America. Its purpose is to promote the interests of botanical gardens and arboretums and to promote the interest of the general public in living plants.

The official organ is the magazine *Parks and Recreation* in which the association has a monthly section, at present consisting of descriptions of the various botanical gardens and arboretums in North America, their objectives and methods of conducting research projects. Also in this section appear various news notes and interesting items concerning rare or unusual plants. This is part of the work of the publication committee, the chairman of which is Henry T. Skinner, curator of the Morris Arboretum, Chestnut Hill, Philadelphia.

The chief undertaking of the association at this early stage is the assimilation of a complete list of plants of a few genera which are growing in this country at the present time. For instance, many a botanical garden has a collection of oaks, maples, junipers, rhododendrons or honeysuckles. Some of these have been collected from many foreign sources, and without the aid of complete inventories from each institution, it is impossible to comprehend exactly what plants are growing here in this country. Naturally, some collections are more complete than others, but it may well be that hidden in the smaller collections are some rare species and varieties, not known to exist in this country. With the increasing uncertainty of foreign horticultural contacts, it becomes more and more important to take stock of what plants are being grown here in the western hemisphere. It is to obtain an inventory on plants in North America that this method has been adopted. The problem will be attacked genus by genus and will take years of painstaking effort, but the idea is a sound one, and it is hoped that the various botanical gardens and arboretums will be sufficiently interested to cooperate in this undertaking and help make it a success. It is not anticipated that all genera will be included, but it is hoped that much will be learned about those genera studied in this way.

There are several other possibilities of cooperation among the members of this new organization. In the first place, it is hoped that some method may be worked out whereby a competent group of judges can be selected who will inspect various collections consisting of one genus or even one species, and report on "the best" for ornamental purposes. An example would be in the case of *Syringa vulgaris*. There are over 300 varieties of the old-fashioned lilac in America to-day, over 150 of them being offered by nurseries. Certainly all do not have outstanding ornamental characteristics. It would be the purpose of this judging committee to study such large groups of lilacs as exist in America, and make recommendations of what would constitute the 10 (or 15) "best" white varieties, the best pink varieties, and so forth, the idea being to help the general public and the commercial growers, in spending time only with those varieties which have demonstrated their superior qualities. This same group of judges, or another like it, could investigate the daffodil, iris and peony collections in the country. Truly an ambitious program! Yet some organization should at least contemplate the possibilities of such a plan, and it is hoped the new Association of Botanical Gardens and Arboretums can work out some recommendations which will prove practical in attempting to tackle the problem.

It is also the purpose of the organization to pub-

licize certain noteworthy plants rarely grown in America at present. Then, too, some mutual system of dissemination of propagating material will be considered, together with plans for certain cooperative hardiness tests. It will be seen that these ambitious plans will take much time to complete, but certainly form the basis on which there can well be a firmer bond between the botanical gardens and arboretums of America.

The officers of this new association are: *Director,* C. Stuart Gager, Brooklyn Botanic Garden, Brooklyn, New York; *Director,* Henry Teuscher, Montreal Botanical Garden, Montreal, Canada; *Chairman,* Donald Wyman, Arnold Arboretum, Jamaica Plain, Massachusetts; *Vice-chairman,* Henry T. Skinner, Morris Arboretum, Chestnut Hill, Pennsylvania; and *Secretary,* C. E. Godshalk, Morton Arboretum, Lisle, Illinois.

DONALD WYMAN,
Chairman

SPECIAL ARTICLES

DIETARY REQUIREMENTS FOR FERTILITY AND LACTATION. XXX. ROLE OF p-AMINOBENZOIC ACID AND INOSITOL IN LACTATION[1]

PRELIMINARY REPORT

RECENTLY I have reported[2] that such large daily doses as 120 μg thiamine, 120 μg riboflavin, 120 μg pyridoxine, 15 mg choline chloride, 600 μg calcium pantothenate, and "W" factor from 1 gm liver extracts (nicotinic acid having been provided in the ration), as a source of the vitamin B complex, resulted in complete failure in lactation of the albino rat, the infant mortality being 95 to 100 per cent. Apparently some dietary factor was missing that is essential for lactation. The missing factor, tentatively designated as "Bx," was found in rice polishings, defatted wheat embryo, dried grass and brewer's yeast, but most abundant in liver and rice bran extracts. A potent concentrate was prepared from the residue of the "W" factor extract by adsorption on fuller's earth. The "Bx" factor was found in the filtrate. On the daily allowance of this concentrate, which was the equivalent of 2 gm of the original liver extracts, 5 mothers successfully weaned 33 out of 34 young given them to rear. The litter of one mother, however, reached maintenance on the 15th day of lactation and maintenance persisted for 7 days. Another litter showed loss of weight on the 17th day and maintenance on the succeeding 3 days. The recent reports of Ansbacher[3] that p-aminobenzoic acid is a chromotrichia factor for the rat, and that of Wooley[4] that inositol is an antialopecia factor for the mouse; also, the report of Pavcek and Baum[5] that inositol is an antispectacled and growth-promoting factor for the rat warranted the trial of these substances. The results with daily doses of 15 mg p-aminobenzoic acid were negative. A daily dose of 30 mg inositol resulted in a prompt response in the case of the first mother, *i.e.,* a gain of 16 gm in 24 hours, and 33 gm in 48 hours in the weights of the litter, and the litter was weaned in 8 days subsequent to the inositol administration. The response to the inositol administration in the case of the second mother was similar.

It was then decided to attempt to rear nursing young of the albino rat on only known pure chemical substances of the vitamin B complex. For this reason the "W" factor was removed from the females at mating. The experiments were conducted in three series, and the following daily additions to the vitamin B complex mixture were given to the mothers during pregnancy and lactation: (1) 15 mg p-aminobenzoic acid; (2) 30 mg inositol; (3) 15 mg p-aminobenzoic acid and 30 mg inositol. The results obtained to date on reproduction and lactation are as follows: Series 1: Out of 92 young born there were only 3 dead, or 3.3 per cent. stillbirths. Out of 53 young given 9 mothers to rear, 32 were weaned. Series 2: Out of 5 litters, 2 were born dead. Two mothers failed in lactation with litters of 6 each. One mother weaned 5 young. Per cent. of stillbirths was 30. Series 3: Out of 46 young born to 5 mothers there was only one stillbirth. Out of 28 young given 5 mothers to rear, 22 were weaned.

It appears from the character of results obtained in this investigation that p-aminobenzoic acid should be added as an essential dietary factor for the rat, as evidenced from studies on reproduction and lactation. It would also seem from the data submitted that the "Bx" factor either contains p-aminobenzoic acid or a substance of similar physiological properties. Further experiments will determine whether inositol is also to be considered a dietary essential for lactation and reproduction of the rat.

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[1] Research paper No. 698, Journal Series, University of Arkansas. Published with the approval of the Director of the Arkansas Agricultural Experiment Station. Aided by a grant from the Committee on Scientific Research of the American Medical Association.

[2] *Proc. American Soc. Biol. Chem.,* Chicago, Ill., April 15–19, 1941.

[3] S. Ansbacher, SCIENCE, 93: 164, 1941.

[4] D. W. Wooley, *Jour. Biol. Chem.,* 139: 29, 1941.

[5] P. L. Pavcek and H. M. Baum, SCIENCE, 93: 502, 1941.

HEARING IN THE RAT AT HIGH FREQUENCIES

THE authors recently discovered that rats sometimes display epileptiform seizures when they are exposed to frequencies of 21 kilocycles and that they show, by their overt behavior, sensitivity to even higher frequencies. It therefore seemed clear to us that the rat hears higher frequencies than does man, but it became a matter of interest to know just what frequencies are audible and how well these frequencies are heard. No data concerning pure tones higher than 8 kilocycles could be found in the literature, so the following experiment was conducted.

Nine rats were taught to run from one part of a compartment to another whenever a tone of 8 kilocycles was presented. Their incentive was to avoid shock. When they had learned this, they were trained to react in similar fashion to other frequencies between 1 and 40 kilocycles. Then the intensity of the tones was reduced step by step until an intensity was reached at which a tone called forth responses from the animal only 50 per cent. of the time. This intensity was taken as the threshold, and it was determined for 1, 2, 4, 8, 14, 21 and 40 kilocycles. (40 kilocycles was the limit of our apparatus.) Except for 21 and 40 kilocycles, similar measurements were taken on eight human subjects.

The average thresholds of the human and animal subjects were compared at different frequencies with the following results. The rat's threshold is much higher than man's at 1 kilocycle, but the difference between the two diminishes as the frequency is increased, until in the neighborhood of 8 kilocycles the sensitivities of man and the rat are the same. At higher frequencies, however, the rat is more sensitive than man, and the discrepancy becomes larger as the frequency is increased. Thus rats are poorer than man below 8 kilocycles and better than man above this frequency.

Any attempt to state the audiogram of the rat in terms of acoustic energy must be based upon somewhat tenuous suppositions concerning the physical characteristics of our apparatus. Nevertheless, even when due account is taken of such considerations, we can state that the absolute sensitivity of the rat most certainly improves as the frequency is increased up to 20 kilocycles. It seems likely, furthermore, that the frequency most audible to the rat is as high as 40 kilocycles. At any rate, our rats hear 40 kilocycles very well, and the upper limit of hearing must, on this account, be a very high frequency indeed.

No animal in whom hearing has been studied at all adequately presents such a disposition of auditory sensitivity as this. Cats and dogs[1] hear best at a higher frequency than man, and their upper frequency-limit is higher, but the rat surpasses them in both respects. Of other animals so far studied, only the bat[2] shows signs of possessing a similar range of auditory sensitivity; cochlear potentials have recently been observed in this animal up to 98 kilocycles. If more suitable sound-producing instruments than we had at our disposal are available in future experiments, it may be shown that the rat's hearing extends to and beyond this frequency; at least, so our data would lead us to expect.

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[1] S. Dworkin, J. Katzman and G. A. Hutchison, *Jour. Exp. Psychol.*, 26: 281, 1940.

THE GERMINATION OF MAIZE POLLEN

THE pollen of *Zea mays* is recognized as one of the difficult sorts to germinate under artificial conditions. In addition to its value in genetic and cytological studies, preliminary experiments have suggested that a reliable method for rapidly checking the viability of maize pollen will be necessary in studies of the effect of ecological factors on pollination and yield of maize.

A method has been developed which has given as much as 90 per cent. germination on nutrient medium within 30 minutes after inoculation. A solution containing 0.7 per cent. agar and 15 per cent. sucrose is held at 60 degrees C. in a water bath and transferred with a pipette to a microscope slide. Only enough solution is placed on the slide to form a shallow droplet of approximately 1 cm diameter. The droplet is allowed to harden for 60 seconds at 20 to 25 degrees C. before the pollen is dusted on from a knife blade held about 2 cm above. The slide is immediately transferred to a moist chamber at 23 degrees C. in which the relative humidity is maintained at 90 per cent. Germination counts can be made after 30 minutes, and, with good lots of pollen, should certainly be read within two hours, before a confusing mass of tubes has developed. In practice the tube growth has been arrested by transferring the slides after two hours to another moist chamber at 6 degrees C. in which the material can be preserved intact for two weeks for more leisurely observations.

The most serious problem in germinating maize pollen is the prevention of bursting. Apparently a near isotonic relationship between the nutrient medium and the cytoplasm is required, with the balance slightly on the hypotonic side so that the pollen grain may absorb water for tube growth, but not rapidly enough to cause bursting. With different lots of highly viable pollen the sucrose percentage showing maximum germination has varied between 10 and 15 per cent. Although no sugar determinations have been made for

[2] R. Galambos, SCIENCE, 93: 215, 1941.

maize pollen, grains treated with an alcoholic solution of IKI reveal wide differences in starch content. It may well be that ecological conditions prior to pollen shedding influence the sugar content of the grains. It is not known whether a reduced osmotic value in the grain is due to the use of some of the sugars in increased respiration or whether sugars may be readily changed to insoluble forms and thus play no part in the osmotic force of the cell. More consistent results

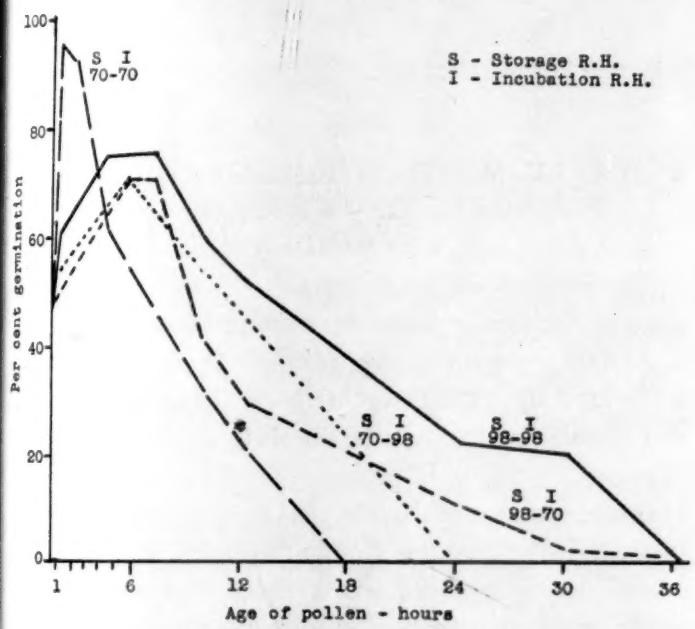

FIG. 1. Effect of age and relative humidity during storage and incubation on the germination of maize pollen.

have been obtained when pollen was taken from cut tassels stored overnight to several days at constant humidity and temperature, perhaps because more uniform osmotic values are obtained with such preliminary treatment.

A major factor in the success of the method is the degree of imbedding of the pollen grains in the still soft agar, and the agar percentage, temperature and cooling rate are important in this connection. Best results have been obtained when the grains were two thirds imbedded and one third exposed to the air. Presumably these conditions favor absorption of both water and oxygen. Covering the pollen has prevented germination. Germinating at 90 per cent. rather than higher humidity reduces bursting due to the formation of free moisture films on the agar. Good germination has been obtained in many experiments at 60 per cent. humidity, although shorter tubes were produced in the drying agar. The data of Fig. 1 show that germination under artificial conditions improved with storage for about six hours after shedding, then declined rapidly. One lot of pollen remained viable after 10 days storage at 8 degrees C. Longer storage life was obtained at the higher humidities, but many lots of pollen stored in nearly saturated air suddenly appeared to become moist and to clump together and thereafter showed no germination.

Maize pollen has germinated poorly on fructose and progressively better on glycerine, glucose and sucrose used at equivalent molarities. Tubes have been produced at pH 4.0 to 8.4. Under optimum conditions the elongation of the pollen tube is sufficiently rapid to be plainly visible under the microscope, and when projected on a screen by a micro-projector so that the grain appeared as large as a grapefruit, the image of the growing point has progressed as much as 1 cm a minute. Tube lengths have frequently reached fifty times the diameter of the pollen grain, although no attempt to stimulate tube growth, as distinct from germination, has been made.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE DAILY REMOVAL OF FORMALIN FROM PRESERVED BIOLOGICAL SPECIMENS USED IN CLASS WORK

INSTRUCTORS and students who are exposed repeatedly to the formalin contained in preserved biological specimens often find their laboratory periods extremely disagreeable and, occasionally, hazardous. Induction or aggravation of the common cold, severe dermatitis, bronchitis and asthma are the chief hazards of exposure to formalin. A method is needed to remove this common laboratory preservative.[1]

Dr. Foust, *et al.*,[2] reported the value of a 5 per cent. urea and 1 per cent. ammonium phosphate solution in removing formalin from preserved specimens. Following the directions given in this article, the writers attempted to deformalinize bullfrogs, dogfish, starfish, etc., but failed to obtain satisfactory results. Therefore, we sought to develop another method to achieve the desired result.

After making a series of small-scale tests with some forty laboratory reagents known to react with formalin, we selected sodium bisulfite, $NaHSO_3$, as most closely approximating our objective, *viz.*, of finding a convenient, quick, cheap and efficient method for removing formalin. An aqueous solution of this reagent was entirely suitable in so far as it completely destroyed the formalin odor of preserved specimens

[1] P. H. Pope, SCIENCE, 73: 495, 1931.
[2] H. F. Foust, T. S. Leith, H. M. Tabbut and L. Bowstead, SCIENCE, 83: 498, 1935.

immersed in it within 3 to 5 minutes. The largest specimens required the greatest length of time.

However, because of the acidity of the formalin resulting from the presence of formic acid, sulfur dioxide gas, SO_2, was liberated from the $NaHSO_3$ solution in such quantities as to nullify its usefulness in a classroom procedure. It appeared that this source of SO_2 could be eliminated simply by reducing the H ion concentration of the reactant solution. This was accomplished by buffering the solution with Na_2SO_3.

We may now detail the essential points in the preparation and use of the sulfite-bisulfite solution:

(1) The deformalinizing solution contains 5.7 per cent. (by weight) of $NaHSO_3$ and 3.8 per cent. (by weight) of Na_2SO_3 dissolved in tap water. A deviation of 1 to 5 per cent. from the above figures would probably introduce no serious failure of the solution to function properly. It is our experience that 20–30 liters of the solution will last a full semester in the daily removal of formalin from any specimens in use in a zoology class of 35 students. To prepare 20 liters of solution dissolve 1260 grams of $NaHSO_3$ and 840 grams of Na_2SO_3 in tap water.

(2) Specimens removed from their formalin bath are given a brief preliminary rinsing under the tap, and then immersed in the sulfite-bisulfite solution from 3 to 5 minutes. As many specimens as can be conveniently handled may be deformalinized simultaneously. Following a final quick rinse, the specimens are free of formalin odor and ready for dissection. Large specimens or those which may have been injected with various formalin mixtures may require subsequent short immersions as dissection proceeds.

(3) Failure of the solution after repeated usage to remove the formalin promptly may require the addition of more $NaHSO_3$ just short of the point where SO_2 gas is evolved. Evidence of SO_2 arising during the routine employment of the solution calls for the addition of small amounts of the Na_2SO_3. There is a considerable variation in the actual amounts of $NaHSO_3$ and of Na_2SO_3 in the technical grade of these chemicals. This should be kept in mind and the amount of one or the other reagent increased as may be necessary to give a satisfactory solution. A pH determination of the solution gives a reasonably easy method of ascertaining if it has been properly prepared. The solution of the concentration specified has a pH of about 6.4. One containing insufficient Na_2SO_3 and which may therefore evolve sulfur dioxide, will have a lower pH. One containing an excess of Na_2SO_3 will have a higher pH.

(4) Although certain specimens, frogs for example, may be stored for several weeks in the reactant solution without impairing their dissecting qualities, others such as the dogfish become soft after 5 to 6 days and unsuitable for dissection. In other words, the solution is not a substitute for formalin. After the removal of the formalin, the specimen may be kept in any other satisfactory preservative, or returned to formalin.

(5) The solution should be kept in common glazed earthenware laboratory crocks, as it will slowly attack metal containers.

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A SIMPLE METHOD FOR REMOVING THE PLUNGERS OF "FROZEN" GLASS SYRINGES

THE method of removing the plungers of "frozen" glass syringes suggested by Goff in SCIENCE, Vol. 93, page 602, was of much interest to us. While we make no claim whatever to originality, we feel justified in calling attention to the method of removing the plungers of "frozen" glass syringes used in our laboratory, because of its simplicity and usefulness, and because many persons are unfamiliar with it.

All that is required is a syringe with a plunger of lesser diameter than the plunger of the "frozen" syringe, and equipped with a short hypodermic needle. We often use a 1 cc Yale tuberculin syringe. The needle passes through a small bit of rubber, such as a piece of a wide rubber band which acts as a gasket. The tuberculin syringe is filled with water, and the needle inserted into the outlet of the "frozen" syringe, the piece of rubber making an airtight seal. Water is then forced from the tuberculin syringe into the "frozen" syringe, until the plunger of the latter is free. It may be necessary to fill the tuberculin syringe with water a number of times, but the method almost never fails.

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